Scale and Dimensions of Human Development

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Abstract

This article proposes a model of human development centred on the articulation of a scale with three simultaneous levels (individual, sociocultural, ecological) and four dimensions — physical, intellectual, volitional and prospective — which combine into a matrix of 12 nodes. Each level corresponds to an interdependent set of human needs (personal, social, environmental), such that human development is conceived as a process of capacity expansion oriented towards the simultaneous satisfaction of these needs. The foundations of human developmental potential are presented: lifelong brain plasticity and learning capacity at any age, rejecting hereditary determinism (IQ) and fixed universal stages. Finally, the non-linear dynamics of development are described: systematic differences between chronological age and biological age (maturational asynchrony that widens with age), presence of qualitative and quantitative leaps, plateaus and regressions, and critical hormonal periods that modulate each dimension.

Keywords: Human development, scale, levels, dimensions, human needs, lifelong plasticity, maturational asynchrony, non-linearity, critical periods.

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1. Introduction: The Need for a Multidimensional Scale Model

Traditional models of human development (Piaget, Kohlberg, IQ psychometrics) have imposed two false ideas: that there is a universal sequence of stages and that potential is fixed by heredity. Both assumptions have been refuted by neuroscience (Diamond, 2001; Eagleman, 2020), cultural psychology (Rogoff, 2003; Nisbett, 2003), cognitive developmental psychology (Gopnik, 2016),

ethology (de Waal, 2006; Harlow, 1958), dynamic systems theory (Thelen & Smith, 1994) and research on expertise (Ericsson & Pool, 2016).

In response, we propose a model that takes as its axis a developmental scale composed of three simultaneous relational levels (the spheres in which the human being exists and develops) and four internal dimensions (the domains of capacity that can be cultivated). This system generates a matrix of 12 nodes that allows the developmental state of any person at any moment of their life to be described, without presupposing fixed hierarchies or universal stages.

The model is organised into three main blocks:

1. Definition of the scale, its three levels and the four dimensions, and their link with human needs (sections 2, 3 and 4).
2. The potential of human development: lifelong brain plasticity and learning capacity, rejection of hereditary determinism (section 5).
3. The non-linear dynamics of development: differences between chronological and biological age, qualitative and quantitative leaps, critical periods and recursivity (section 6).

Finally, conclusions are presented (section 7).

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2. The Scale of Human Development and Its Levels

By developmental scale we understand the continuum that integrates the different related levels in which the human being simultaneously unfolds their existence. They are not phases or stages, but three interconnected levels of analysis: individual, social and natural.

2.1 Personal Level (Individual Being)

This is the level of the self that recognises itself as distinct and exercises capacities for self-regulation, choice and the construction of a life project. It involves self-concept, reflective consciousness, functional autonomy and the management of one's own life. Its development requires the satisfaction of personal needs (physiological, security, identity, purpose). The neuroscience of the self (Damasio, 2010; Thelen & Smith, 1994) shows that reflective consciousness emerges from the integration of bodily signals and neural maps, biologically grounding this level.

2.2 Social Level (Sociocultural Being)

It encompasses family, friendship networks, community, institutions and culture. Development at this level involves learning shared languages, roles, norms and modes of cooperation. Its biological basis includes specific brain circuits for social cognition (Lieberman, 2013), the need for attachment and the evolutionary heritage of empathy and reciprocity (De Waal, 2006). It requires the satisfaction of social needs (bonding, recognition, justice, cooperation).

2.3 Natural Level (Ecological Being)

The human being is a living organism that depends on ecosystems. This level, forgotten in traditional models, includes the relationship with water, soil, climate, other species and natural rhythms. Its development requires the satisfaction of environmental needs (clean air/water/soil, shelter, mobility, nature, stimulus complexity). Endosymbiotic theory (Margulis, 1998) and the Gaia hypothesis (Lovelock, 1979) show that life is a network of symbiotic interdependencies in which the human being is one more species, biologically grounding this level.

Interdependence of levels: No level is superior to another. A deficit at the ecological level (pollution, absence of nature) generates discomfort at the individual level (stress, illness) and at the sociocultural level (conflicts, isolation). They operate simultaneously: the satisfaction of the needs associated with all three levels is the condition for full development.

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3. The Four Dimensions of Human Development

The dimensions designate what develops within each level of the scale. We propose four dimensions, which in the original Integral Zone of Proximal Development (IZPD) model (Mascarell, 2024c) are called Power, Knowledge, Will and Belief, and which we here rename as physical, intellectual, volitional and prospective to underline their scope and facilitate dialogue with other traditions. They are irreducible, plastic and require specific scaffolding.

3.1 Physical Dimension (Power: Executive Capacities, What One Can Do)

It encompasses the competencies to act transformatively upon the environment: motor skills, strength, coordination, tool handling, procedural abilities. It includes physical power. Enactive cognition (Varela, Thompson & Rosch, 1991) shows that this dimension is constitutive of knowledge.

3.2 Intellectual Dimension (Knowledge: What One Knows)

It includes declarative knowledge (data, theories), procedural knowledge and practical wisdom. Following Gopnik (2016), learning is the construction of probabilistic causal models, not the unfolding of fixed stages.

3.3 Volitional Dimension (Will: Motivations and Emotions, What One Feels and Wants)

It comprises emotions, desires, goals, interests, intrinsic and extrinsic motivation. Self-determination theory (Ryan & Deci, 2017) shows that autonomous motivation is the engine of development. Ethology (de Waal, 2006) evidences the evolutionary roots of empathy.

3.4 Prospective Dimension (Belief: Beliefs, Expectations, Worldviews, What One Believes)

It gathers convictions about oneself (self-efficacy, self-concept), about others and about the world. Dweck (2006) demonstrated the power of the growth mindset. Bandura (1997) showed that self-efficacy predicts performance. It is prospective because every belief about the present or the past is, in reality, a hypothesis that guides the future.

Interdependence of dimensions: The four dimensions feed back recursively. A deficit in the prospective dimension (e.g., "I'm not good at this") inhibits the volitional (lack of motivation), which reduces practice and therefore the physical and intellectual. Conversely, an improvement in the physical dimension (achievement of a skill) can strengthen the prospective and volitional.

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4. Development Matrix: Articulation of Levels and Dimensions (NODES)

The intersection of the three levels of the scale with the four dimensions produces twelve development nodes (Table 1). Each node represents a plastic, culturally situated domain that can be assessed through levels of complexity (from basic to expert) and whose improvement requires the satisfaction of the corresponding needs.

Table 1. Matrix of levels and dimensions of human development

Level \ Dimension	Physical (Power)	Intellectual (Knowledge)	Volitional (Will)	Prospective (Belief)
Individual	Self-care, motor skills, strength, coordination	Self-knowledge, technical knowledge, metacognition	Emotional recognition, self-motivation, frustration tolerance	Self-esteem, self-efficacy, mindset
Sociocultural	Non-verbal communication, collective coordination, rituals	Language, shared history, collective intelligence	Empathy, affective bonds, belonging, ethical indignation	Implicit social contract, prejudices, ideals of justice
Ecological	Cultivation, shelter building, ecological sensoriality	Landscape reading, ecological knowledge, natural cycles	Wonder, biophilia, ecological grief, desire for preservation	Worldview (anthropo-/eco centrism)

Each node has its own trajectory, simultaneously associated with and constrained by the others. It is not presupposed that a high level in one node (e.g., Individual-Intellectual) implies high levels in others, but development does depend on a dynamic equilibrium both between levels and between dimensions.

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5. The Potential of Human Development: Lifelong Plasticity and Rejection of Hereditary Determinism

5.1 Lifelong Brain Plasticity

Neuroscience has demonstrated that the brain maintains its capacity for synaptic and functional reorganisation throughout life (Diamond, 2001; Eagleman, 2020). There are no "closed critical periods" for most complex learnings; there are sensitive periods of greater facility, but not of impossibility. An older adult can learn a new language, an instrument or a technical skill if provided with an appropriate environment.

5.2 Rejection of Hereditary Determinism (IQ and *g* factor)

IQ psychometrics imposed the idea of a fixed and hereditary general intelligence factor (*g*). This notion has been refuted by:

- Evidence that IQ is highly modifiable by the environment (Flynn, 2012).
- Research on expertise (Ericsson & Pool, 2016), showing that exceptional performance requires deliberate practice, not innate gifts.
- Heritability studies which, when controlling for talent niche quality, drastically reduce the variance attributed to genes (Tucker-Drob & Bates, 2016).

5.3 Domain Talent and Talent Niche

Instead of a fixed general potential, we propose the concept of domain talent (Mascarell, 2024b): the ability to handle increasing levels of complexity in a specific domain, developed through deliberate practice in a talent niche (an environment that provides graded tasks, expert feedback, motivational support and resources). Potential is measured by the learning slope (rate of improvement under optimal conditions), not by a static baseline level. This potential exists at all ages, although learning speed may vary.

5.4 Fundamental Implication

Human development is not limited by a genetic "ceiling" or by chronological age. The function of educational and social systems is to cultivate talents by providing appropriate talent niches, not to select supposedly gifted individuals through tests.

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6. The Non-Linear Dynamics of Development

Human development does not follow a linear or predictable sequence. It presents non-linear trajectories characterised by:

6.1 Systematic Differences Between Chronological Age and Biological Age (Maturational Asynchrony)

Chronological age (years lived) is a poor predictor of the level of development in any node. Biological age — maturation of the nervous system, hormonal development, metabolic health, functional state — varies enormously among individuals of the same chronological age. This variability is especially wide at puberty (a 4-year range at 12 chronological years) and widens with age: at 50 chronological years, biological age can range between 40 and 60 years (a 20-year range).

Consequences:

- Two people of the same chronological age may differ by 20 years of biological age in middle adulthood.
- Grouping by chronological age (school classes, work cohorts, retirement age) generates injustices and avoidable failures.
- Development assessment should be based on biological age indicators (Tanner stages, hormonal profile, functional capacity), not on date of birth.

6.2 Qualitative and Quantitative Leaps, Synergies and Dynamic Reorganisation

Development presents leaps (sudden improvements after plateau periods) and regressions (temporary or permanent losses of capacity). These phenomena are normal and do not indicate failure.

From Gestalt theory, development does not consist of a mere accumulation of elements, but of the emergence of organised wholes that possess properties qualitatively different from the sum of the parts. A developmental leap is the irruption of a new configuration (gestalt) that suddenly reorders the field of possibilities; for example, the acquisition of literacy or the understanding of an abstract concept are not simple sums of previous skills, but reorganisations that give new meaning to the whole.

Esther Thelen's dynamic systems theory (Thelen & Smith, 1994) explains these leaps as phase transitions in a self-organising system. Development is a process of "soft assembly" in which multiple components — the physical, intellectual, volitional and prospective dimensions, together with environmental conditions — interact in real time. When the stability of the system is weakened by internal or external changes, a sudden reorganisation towards a new attractor occurs, i.e., a qualitative leap. The preceding plateau represents a period of stability, and the leap a non-linear response to amplified fluctuations of the system.

Positive and negative synergies between dimensions. The interaction between dimensions can generate interference or reciprocal potentiation effects that underlie leaps and regressions:

- **Positive synergy:** a small advance in the physical dimension (achieving a new motor skill) can immediately reinforce the prospective ("I am capable"), which in turn increases the volitional (desire to keep practising), leading to greater intellectual development (understanding of the task) and a new cycle of practice. This chaining can precipitate a sudden leap in performance, far greater than what each dimension would have produced separately. The totality of the change is a gestalt: confidence, motivation and technique merge into a unified act.
- **Negative synergy:** a failure in the physical dimension can undermine the prospective, which inhibits the volitional and stagnates the intellectual. Negative feedback between dimensions can trigger a rapid regression, where the system collapses towards a lower-complexity attractor (e.g., abandonment of an activity or fixation on childish strategies).

These synergies are non-linear: a small dimensional change can, under conditions of instability, trigger a large behavioural leap. The gestalt perspective underlines that the leap is not in any of the isolated components, but in the new configuration that integrates them.

6.3 Critical Hormonal Periods and Their Influence on Quantitative and Qualitative Physical Development

Hormones act as neuromodulators that alter synaptic plasticity, brain connectivity and stress response, but they also directly control growth and bodily reorganisation. There are periods of special sensitivity that differentially affect quantitative physical development (muscle mass, bone density, height, maximum strength) and qualitative physical development (coordination, motor patterns, fluency, balance, movement efficiency):

- **Prenatal and minipuberty (0-6 months):** organisation of visuospatial circuits and stress response. Quantitative physical development consists of rapid initial somatic growth; qualitatively, the first patterns of sucking, grasping and muscle tone are established, the basis for future coordinations.
- **Adrenarche (6-8 years):** the increase in DHEA contributes to the onset of bone elongation and the development of lean muscle mass (mild quantitative changes). Qualitatively, it improves running economy, throwing precision and visuomotor timing, allowing more fluid and adjusted movements.

- **Puberty (8-15 years):** this is the period of maximum quantitative change: accelerated height growth (pubertal growth spurt), increased muscle mass, widening of the thoracic cage and changes in body proportion (sexual dimorphism). Qualitatively, rapid growth generates a temporary mismatch in coordination: adolescent clumsiness reflects the need to recalibrate sensorimotor maps in response to body segments that have changed their length and inertia. During this phase, basic motor patterns (gait, posture, sports gestures) are rewritten and new athletic or artistic capacities can emerge. It is the most critical period for physical education and technical skill training because motor system plasticity is maximal.
- **Pregnancy:** quantitative changes in body volume, weight and ligamentous laxity (due to relaxin). Qualitatively, the centre of gravity and gait biomechanics are altered, requiring a readaptation of postural and movement patterns. Many women experience a reorganisation of bodily awareness and efficiency in daily activities.
- **Perimenopause (40-55 years):** oestrogen decline accelerates bone and muscle mass loss (incipient sarcopenia), i.e., quantitative decline. Qualitatively, joint stiffness, reduced dynamic balance and changes in gait fluidity may appear. However, deliberate exercise practice can maintain and even improve movement quality, compensating for quantitative loss with more refined qualitative strategies (greater postural awareness, use of more efficient levers).
- **Andropause (from 40-50 years):** gradual testosterone decline entails loss of strength and muscle mass (quantitative) and possible slowing of rapid and explosive movements (qualitative). Fine coordination capacity and refined technique can be preserved or even improved if practice is maintained, showing that the intellectual-physical dimension can compensate for hormonal decline.
- **Advanced ageing (>70 years):** quantitative decline continues (severe sarcopenia, osteoporosis, reduced aerobic capacity). Qualitatively, gait becomes more cautious, adaptive motor variability decreases and fall risk increases. Despite this, deeply automated patterns (procedural wisdom) are usually preserved, and specific training can recover much of the qualitative functionality through reorganisation of available resources (use of visual cues, external rhythms, cognitive scaffolding).

Each of these periods modulates not only the physical body, but also the relationship between dimensions. For example, pubertal changes in the physical dimension interact with the volitional-sociocultural and the prospective-individual; strength loss in andropause can trigger involutionary loops in the prospective dimension if no intervention is made. Knowing the dual quantitative and qualitative aspect of physical development allows the design of

environments that take advantage of plasticity windows and offer support during vulnerability phases.

6.4 Recursivity and Developmental Loops

The four dimensions continuously feed back, potentially generating evolutionary loops (synergistic improvement) or involutionary loops (cumulative deterioration). For example:

- **Evolutionary loop:** a small success in the physical dimension improves the prospective, which increases the volitional, leading to more practice and improvement of the intellectual.
- **Involutionary loop:** a loss in the physical dimension (due to ageing) damages the prospective ("I can't anymore"), reduces the volitional and leads to disuse, which accelerates the loss.

Recursivity implies that it is never too late to intervene: by acting on the most accessible dimension (often the prospective through psychoeducation or micro-successes) an involutionary loop can be reversed at any age.

6.5 Educational and Social Implication

Non-linear dynamics demand:

- Abandonment of teaching by chronological age.
- Individualised assessment of biological age and complexity level in each node.
- Design of interventions sensitive to critical periods (taking advantage of opportunity windows, protecting during vulnerability phases).
- Recognition that setbacks are normal and can be compensated.

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7. Conclusions

1. The proposed model articulates a scale of three simultaneous levels (individual, sociocultural, ecological) and four dimensions — physical (Power), intellectual (Knowledge), volitional (Will) and prospective (Belief) — in a matrix of 12 nodes, which allows human development to be described without presupposing universal stages.
2. Each level of the scale corresponds to a set of needs (personal, social, environmental), interdependent and based on biological symbiosis. The

simultaneous satisfaction of these needs is the normative criterion of development.

3. Human developmental potential is not fixed by heredity or IQ. Brain plasticity is lifelong, and talent is developed as domain talent through deliberate practice in a talent niche. The learning slope (rate of improvement) is the true indicator of potential.
4. Development has a non-linear dynamics: there are systematic differences between chronological age and biological age (asynchrony that widens with age), qualitative and quantitative leaps, plateaus and regressions, and critical hormonal periods that modulate each dimension.
5. The recursivity of the four dimensions generates evolutionary and involutionary loops. This allows intervention at any age to break negative loops.
6. The educational and policy implications are radical: abandonment of chronological age organisation, assessment based on biological age and complexity levels, investment in talent niches for all, and design of interventions sensitive to critical periods.

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